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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/418,818	10/15/1999	DAVID CHEUNG	AM1084D01/T9	9377

32588 7590 07/02/2004
APPLIED MATERIALS, INC.
2881 SCOTT BLVD. M/S 2061
SANTA CLARA, CA 95050

EXAMINER

ZERVIGON, RUDY

ART UNIT PAPER NUMBER

1763

DATE MAILED: 07/02/2004

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**BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES**

Application Number: 09/418,818
Filing Date: October 15, 1999
Appellant(s): CHEUNG ET AL.

MAILED
JUL 02 2004
GROUP 1700

Chun-Pok Leung
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed April 26, 2004.

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(1) *Real Party in Interest*

A statement identifying the real party in interest is contained in the brief.

(2) *Related Appeals and Interferences*

A statement identifying the related appeals and interferences which will directly affect or be directly affected by or have a bearing on the decision in the pending appeal is contained in the brief.

(3) *Status of Claims*

The statement of the status of the claims contained in the brief is correct.

(4) *Status of Amendments After Final*

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) *Summary of Invention*

The summary of invention contained in the brief is correct.

(6) *Issues*

The appellant's statement of the issues in the brief is correct.

(7) *Grouping of Claims*

The appellant's statement in the brief that certain claims do not stand or fall together is not agreed with because Appellant's grouping of claims is strictly directed to the scope of each claim.

(8) *Claims Appealed*

The copy of the appealed claims contained in the Appendix to the brief is correct.

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(9) Prior Art of Record

4,888,199	FELTS	12-1989
5,286,581	LEE	2-1994
5,300,460	COLLINS	4-1994
5,364,665	FELTS	11-1994

J. Bately and E. Tiemey, "Low-temperature deposition of high-quality silicon dioxide by plasma-enhanced chemical vapor deposition", J. Appl. Phys. Vol.60, no. 9 (November 1, 1986), pp. 3136-3145

(10) Grounds of Rejection

The following grounds of rejection are applicable to the appealed claims:

Claims 1-6, 9, 10, 44-50, 53-57, and 62 are rejected under 35 U.S.C. 103(a) as being unpatentable over Felts et al (USPat. 4,888,199) in view of J. Batey et al and Fourmun Lee (U.S. Pat. 5,286,581).

Claim 51 is rejected under 35 U.S.C. 103(a) as being unpatentable over Felts et al (USPat. 4,888,199), J. Batey et al, Fourmun Lee (U.S. Pat. 5,286,581), in view of Felts et al (USPat. 5,364,665).

Claims 52, 58, and 59 are rejected under 35 U.S.C. 103(a) as being unpatentable over Felts et al (USPat. 4,888,199), J. Batey et al, and Fourmun Lee (U.S. Pat. 5,286,581), in view of Collins et al (USPat. 5,300,460).

Claims 60 and 61 are rejected under 35 U.S.C. 103(a) as being unpatentable over J. Batey et al in view of Fourmun Lee (U.S. Pat. 5,286,581).

(11) Response to Argument

Applicant states in the first paragraph, page 12:

“

...claim 1 is patentable over the cited references because, for instance, they do not teach or suggest a computer readable program code for controlling the gas delivery system to operate for a specified time period

“

In response, the Examiner has set forth in the final rejection that Felts et al 4,888,199 teaches:

“

a memory (column 10, lines 56-64) coupled to the controller comprising a computer readable program (column 16 - column 46- Felts et al 4,888,199) having a computer readable program embodied therein for directing operation of the substrate processing system, the computer readable program including a first (column 5, lines 16-40) set of computer instructions (column 16 -column 46 - Felts et al- 199) for controlling the gas delivery system to introduce selected deposition gases (column 5, lines 17-40) into the process chamber at deposited gas flow rates

“

Applicant further states in the first paragraph, page 12:

”

...and for causing a layer to be formed to a thickness which is an odd multiple, greater than one, of a wavelength of light to be used in a subsequent process operation on the layer.

“

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In response, the Examiner has set forth in the final rejection that Fourmun Lee teaches Applicant's claimed thickness as being an odd multiple, less than one, of the wavelength of light – Applicant teaches on page 10 that said thickness is:

$$t = \frac{m\lambda}{2n}, \text{ where } t \text{ satisfies } 500\text{\AA} \leq t \leq 3000\text{\AA} \text{ (page 10, lines 20-22)}$$

while Lee teaches an odd multiple ($m = 1$) in column 5, lines 10-15:

$$t = \frac{m\lambda}{2n-2}, m = 1, \text{ where } t \text{ is } 1,738\text{\AA} \text{ for the example of column 5, lines 21-33}$$

Here, Forum Lee's factor of $m/(2(n-1))$ – is the inverse of all odd numbers, for n as integer; column 5, lines 10-15, as such, it is accepted that one of ordinary skill in the art at the time the invention was made would have found it obvious to optimize the operation of the claimed apparatus to achieve the claimed distance. It would be obvious to those of ordinary skill in the art to optimize the operation of the claimed invention as discussed by Lee (column 3, line 62 – column 4, line 27). - In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980); In re Hoeschele, 406 F.2d 1403, 160 USPQ 809 (CCPA 1969); Merck & Co. Inc. v. Biocraft Laboratories Inc., 874 F.2d 804, 10 USPQ2d 1843 (Fed. Cir.), cert. denied, 493 U.S. 975 (1989); In re Kulling, 897 F.2d 1147, 14 USPQ2d 1056 (Fed. Cir. 1990), MPEP 2144.05).

Applicant supports his thicker antireflective layers, as being nonobvious in view of Forum Lee, according to the stated advantages of the specification (page 10, line 14 to page 11, line 14) and is reemphasized in the Appeal Brief (third paragraph, page 12):

“

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a number of advantages of using thicker antireflective layers by selecting a thickness that is an odd multiple, greater than one, of a wavelength of light to be used in a subsequent process on the layer. For instance, the increased thickness achieves improved film consistency from wafer to wafer; provides better control of the refractive index, absorptive index, and thickness of the film; and renders the film suitable for use as a hard mask during an etching step

“

In response, the Examiner sets forth that Forum Lee also teaches similar benefits for film thickness optimization:

“

Typically, phase-shift layer 13 is deposited or applied with a thickness range from 500 angstroms to 5,000 angstroms. Generally, optimal thickness of the phase-shift layer 13 is dependent upon material selection, but also on a desired amount of change or shift in the light. Optimization of the thickness of phase-shift layer 12 is discussed in FIG. 2.

“ (column 3, lines 60-64; Figure 2)

Applicant states in 4th paragraph, page 12:

“

It is the inventors, not the cited references, that disclosed the reasons for using the odd multiples of greater than one (e.g., to achieve improve film consistency from wafer to wafer; provide better control of the refractive index, absorptive index, and thickness of the film; and renders the film suitable for use as a hard mask during an etching step)

“

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In response, the Examiner cites Forum Lee again who teaches benefits for film thickness optimization:

“

Typically, phase-shifting is achieved by passing light through areas of a transparent material of either differing thicknesses or through materials with different refractive indexes, thereby changing the phase or the periodic pattern of the light wave. Phase-shift masks reduce diffraction effects by combining both diffracted light and phase-shifted light so that constructive and destructive interference takes place.

“

Applicant states in the first paragraph, page 14 of the Appeal Brief:

“

..claim 51 recites that the substrate support is spaced from the gas distribution system at a distance in the range of 200-600 mils. Felts et al '665 does not cure the deficiencies of the other references.

“

In response, as the Examiner stated in the Final Rejection page 8:

“

Felts et al (USPat.5,364,665) teaches:

xviii. a substrate support is spaced “ Δ ” (column 6, line 62-col.7, line 10) from the gas distribution system at a distance in the range of 200-600 mils = 0.2-0.6 inches, where mils is interpreted as milli-inches – “Distance should be no greater than about 12 inches... or - $\Delta < 12$ ”

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It would have been obvious to one of ordinary skill in the art at the time the invention was made for Felts et al (USPat. 4,888,199) to space the substrate support from the gas distribution system at a distance in the range of 200-600 mils = 0.2-0.6 inches taught by Felts et al (USPat.5,364,665).

Motivation for Felts et al (USPat. 4,888,199) to space the substrate support from the gas distribution system at a distance in the range of 200-600 mils = 0.2-0.6 inches is to effect sufficient plasma confinement as taught by Felts et al (USPat.5,364,665; column 6, lines 65-68).

“

Applicant states in the second paragraph, page 14 of the Appeal Brief:

“

...claim 52 recites that the selected deposition gases further comprise NH_3 flowed into the chamber at a rate of less than 300 sccm; and N_2 flowed into the chamber at a rate of less than 4000 sccm. Collins et al '665 does not cure the deficiencies..

“

In response, as the Examiner stated in the Final Rejection page 8:

“

Collins teaches a method of producing semiconductor films (abstract). Specifically, Collins teaches deposition gases further comprising NH_3 flowed into the chamber at a rate of less than 300 sccm, and N_2 flowed into the chamber at a rate of less than 4000 sccm (column 12, lines 58-68).

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It would have been obvious to one of ordinary skill in the art at the time the invention was made for Felts et al (USPat. 4,888,199) to replace nitrous oxide with the deposition gases of NH_3 and N_2 at the flow rates taught by Collins.

Motivation for Felts et al (USPat. 4,888,199) to replace nitrous oxide with the deposition gases of NH_3 and N_2 at the flow rates taught by Collins is to produce silicon nitride films (column 12, lines 59-60).

“

Applicant states in the first paragraph of page 16 of the Appeal Brief:

“

...the references do not teach or suggest means for flowing N_2O through the gas distribution system at a flow rate of 5-300 sccm, wherein a ratio of the selected flow rate of He to the combined flow rate of SiH_4 and N_2O is at least 6.25:1 to deposit an antireflective layer on the substrate at a deposition rate which is lower than a deposition rate using the same flow rate of SiH_4 and the same flow rate of N_2O with a lower flow rate of He and to a thickness which is an odd multiple, greater than one, of ...

“

In response, the Examiner has conveyed:

Batey teaches a method of helium dilution to achieve low deposition rates and high quality films (Underlined Summary text). Specifically, Batey teaches that the helium introduction is provided to achieve a desired low deposition rate from a plasma enhanced reaction of the selected deposition gases of silane and nitrous oxide (Section II), the desired low deposition rate being lower than a deposition rate using the selected deposition gases at the deposition gas flow rates

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with a lower flow rate of the inert gas (underlined text, Section III), to produce a plasma enhanced reaction of the deposition gases in the process chamber to deposit a film at the low deposition rate (section V, underlined text). Batey also teaches:

- i. a process chamber ("Plasma Therm PK1250", Section II)
- ii. a substrate support (not shown), located within the process chamber, for supporting a substrate (required)
- iii. a gas delivery system (not shown) means for flowing (conveyance pipe) selected deposition gases into the process chamber at deposition gas flow rates (Table I, Page 3138)
- iv. maintaining chamber pressure between 1 and 6 Torr (Section III, underlined text)
- v. equivalent means for heating the substrate to a temperature between 200°C and 400°C (Section III, underlined text)

Batey also teaches a method of helium dilution to achieve low deposition rates and high quality films (Underlined Summary text). Specifically, Batey teaches that the helium introduction is provided to achieve a desired low deposition rate from a plasma enhanced reaction of the selected deposition gases of silane and nitrous oxide (Section II), the desired low deposition rate being lower than a deposition rate using the selected deposition gases at the deposition gas flow rates with a lower flow rate of the inert gas (underlined text, Section III), to produce a plasma enhanced reaction of the deposition gases in the process chamber to deposit a film at the low deposition rate (section V, underlined text). Batey also teaches:

- vi. a chamber pressure in the range of 1-6Torr (underlined text, Section III)

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- vii. silane (SiH_4) and nitrous oxide as nitrogen source (N_2O) equivalent means for flowing into the chamber at a rate of 5-300 sccm (Section II, Table I) where the helium (He) to combined silane (SiH_4) and nitrous oxide (N_2O) ratio of 6.25:1 or greater – ($2000/140 = 14.28/1$)
- viii. a heater to heat the substrate to a temperature in the range of 200-400°C (underlined text, Section III)
- ix. power applied to the process chamber at 25 Watts (underlined text, Section III)
- x. the volumetric flow rate of silane (SiH_4) is 0.5 to 3 times the volumetric flow rate of nitrous oxide (N_2O) – $0.5 < (\text{SiH}_4) / (\text{N}_2\text{O}) < 3.0$ because Batey teaches the claimed ratio at 0.4 – See Table I, page 3138
- xi. the nitrous oxide (N_2O) flow rate between 15 to 160 sccm because Batey teaches nitrous oxide (N_2O) a flow rate of 100 sccm (Table I)

Applicant states in the second paragraph, page 16 of the Appeal Brief:

“

...claim 58 and 59 are patentable for at least the same reasons that claim 57 is patentable. Moreover, claim 58 from which claim 59 depends recites means for introducing NH_3 into the chamber at a rate of 0-300 sccm. Collins et al '655 does not cure the deficiencies of the other references.

“

In response, the Examiner has asserted in the Final Action page 9 that Felts '199 teaches equivalent means (compare Applicant's specification page 6 last paragraph to Felts '199 column 3, lines 59-61; column 6, lines 3-16) gas delivery (item 15, Figure 1,2; col.3, lines 59-61) for

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delivering process gases (col.5,lines 3-40) into the process chamber, and specifically that Felts, Batey, and Lee do not teach deposition gases further comprising NH_3 flowed into the chamber at a rate of less than 300 sccm, and N_2 flowed into the chamber at a rate of less than 4000 sccm. However, as stated in the final rejection:

“

Collins teaches a method of producing semiconductor films (abstract). Specifically, Collins teaches deposition gases further comprising NH_3 flowed into the chamber at a rate of less than 300 sccm, and N_2 flowed into the chamber at a rate of less than 4000 sccm (column 12, lines 58-68).

It would have been obvious to one of ordinary skill in the art at the time the invention was made for Felts et al (USPat. 4,888,199) to replace nitrous oxide with the deposition gases of NH_3 and N_2 at the flow rates taught by Collins.

Motivation for Felts et al (USPat. 4,888,199) to replace nitrous oxide with the deposition gases of NH_3 and N_2 at the flow rates taught by Collins is to produce silicon nitride films (column 12, lines 59-60).

“

Applicant states in the third paragraph, page 16 of the Appeal Brief:

“

Applicants respectfully submit that claim 60 is patentable over the cited references because, for instance, they do not teach or suggest means for forming a layer of photoresist on the antireflective layer, the antireflective layer having a thickness and refractive indices such that a first reflection from an interface between the photoresist and the antireflective layer of an

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exposure light will be an odd number which is at least 3 multiplied by 180° out of phase with a second reflection from an interface between the antireflective layer and the substrate layer of the exposure light.

“

Applicant further states in the second paragraph, page 16 of the Appeal Brief:

“

...claim 61 is patentable over the cited references because, for instance, they do not disclose or suggest means for forming a photoresist pattern by exposing the photoresist layer to an exposure light having a wavelength of 365nm or less and developing the exposed photoresist layer, wherein a phase shift of an odd multiple of at least 3 multiplied by 180° exists between between a first reflection of the exposure light from an interface between the photoresist layer and the antireflection layer and a second reflection of the exposure light from an interface between the antireflective layer and the first layer, the first reflection having almost the same intensity as the second reflection to thereby substantially cancel the first and second reflections

“

Applicant states in the fourth paragraph of page 18 in the Appeal Brief:

“

...claim 62 is patentable over the cited references because, for instance, they do not disclose or suggest means for depositing a thin film on the substrate at said low deposition rate from said reaction of said deposition gases to a thickness which is an odd multiple, greater than one, of a wavelength of light to be used in a subsequent process operation on the film.

“

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To the contrary, the Examiner has asserted in the Final Rejection that Felts et al (USPat. 4,888,199) teaches equivalent means for film formation - compare Applicant's structural components in page 5, line 25 - page 6, line 24 to the Examiner's citation of Felt's 4,888,199 structural components. Further, it was asserted, regarding film formation steps, that Fourmun Lee teaches:

“

means for forming a layer of photoresist (14, Fig.1;column 3, line 65- col.4, line 5) on the antireflective layer (13, Fig.1;column 3, lines 46-64), the antireflective layer (13, Fig.1;column 3, lines 46-64) having a thickness ("d", col.5, lines 10-15) and refractive index ("n", col.5, lines 10-15) such that a first reflection from an interface between the photoresist and the antireflective layer of an exposure light ("L", col.5, lines 10-15) will be an odd number (1, in this case; column 5, line 6) which is not at least 3 multiplied by 180° (in radians) out of phase with a second reflection from an interface between the antireflective layer and the substrate layer (12', 13'; column 5, lines 5-10) of the exposure light; and means for forming a photoresist pattern (column 5, lines 52-57) by exposing the photoresist layer to the exposure light and developing the exposed photoresist layer

A silicon nitride and silicon oxynitride antireflective layer (12', 13'; column 5, lines 20-30; column 3, line 49) with refractive index in 1.7-2.9 (2.05, column 5, line 27) and a thickness of 200-3000 (1,738 ; column 5, line 27) and an light exposure wavelength of 365nm or less (column 5, line 24).

“ Lee also supports the teaching of phase shift masks (column 1; lines 38-49) for “improved resolution and depth of focus” of the developed mask. Applicant’s claimed “the first reflection having almost the same intensity as the second reflection to thereby substantially cancel the first and second reflections” concept is completely embodied within the teaching of Lee’s constructive and destructive interference patterns as taught by Lee (column 1; lines 38-49).

According to the rejection:

“

Although Fourmun Lee teaches only n radians, where $n=1$, out of phase between consecutive areas 12' and 13', it would have been obvious to one of ordinary skill in the art at the time the invention was made to realize that odd multiples of radians is the same phase angle.

Although Fourmun Lee does not mention the absorptive index of the antireflective layer for a silicon oxynitride material, it is the position of the examiner that the absorptive index of silicon oxynitride for the claimed wave length of 365nm and taught by Fourmun Lee (column 5, line 24) is a fixed intrinsic property of the silicon oxynitride material for the wavelength in question. As such Fourmun Lee teaches the absorptive index at the wavelength in question.

“

Further, as stated above, Forum Lee’s factor of $m/(2(n-1))$ – is the inverse of all odd numbers, for n as integer; column 5, lines 10-15, as such, it is accepted that one of ordinary skill in the art at the time the invention was made would have found it obvious to optimize the operation of the claimed apparatus to achieve the claimed distance (thickness). It would be obvious to those of ordinary skill in the art to optimize the operation of the claimed invention as discussed by Lee (column 3, line 62 – column 4, line 27). - In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA

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1980); In re Hoeschele , 406 F.2d 1403, 160 USPQ 809 (CCPA 1969); Merck & Co. Inc . v. Biocraft Laboratories Inc. , 874 F.2d 804, 10 USPQ2d 1843 (Fed. Cir.), cert. denied , 493 U.S. 975 (1989); In re Kulling , 897 F.2d 1147, 14 USPQ2d 1056 (Fed. Cir. 1990), MPEP 2144.05).

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

Rudy Zervigon
Examiner
Art Unit 1763

Rudy Zervigon
June 22, 2004

Conferees

Glenn A. Caldarola (SPE 1764)

Parviz Hassanzadeh (Acting SPE 1763) *P. Hassanzadeh*

Rudy Zervigon (Examiner, Art Unit 1763) *Rudy Zervigon*

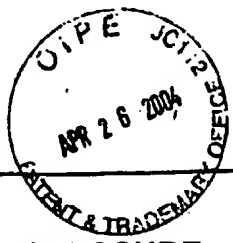
Shrive Beck (SPE 1762) *Shrive Beck*

Patent Counsel, MS/2061

Legal Affairs Dept Applied Materials, Inc.

P.O. Box 450A

Santa Clara, CA 95052



PTO/SB/08B (08-03)

Substitute for form 1449B/PTO INFORMATION DISCLOSURE STATEMENT BY APPLICANT (use as many sheets as necessary)				Complete if Known	
				Application Number	09/418,818
				Filing Date	October 15, 1999
				First Named Inventor	Cheung, David
				Art Unit	1763
				Examiner Name	Rudy Zervigon
Sheet	3	of	3	Attorney Docket Number	AM1084D01/T9320

U.S. PATENT DOCUMENTS+					
Examiner Initials*	Cite No. ¹	Document Number	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		Number Kind Code ² (if known)			
	1	US 4,089,992	05-16-1978	Doo, et al.	
	2	US 4,118,539	10-03-1978	Hirai, et al.	
	3	US 4,279,947	07-21-1981	Goldman, et al.	
	4	US 4,395,438	07-26-1983	Chiang	
	5	US 4,435,898	03-13-1984	Gaur, et al.	
	6	US 4,717,602	01-05-1988	Yamazaki	
	7	US 4,877,651	10-31-1989	Dory	
	8	US 4,894,352	01-16-1990	Lane, et al.	
	9	US 5,932,286	8-13-1999	Beinglass, et al.	

FOREIGN PATENT DOCUMENTS								
Examiner Initials*	Cite No. ¹	Foreign Patent Document			Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T ³
		Country Code ²	Number ⁴	Kind Code ⁵ (if known)				
								<input type="checkbox"/>

NON PATENT LITERATURE DOCUMENTS			
Examiner Initials*	Cite No. ¹	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T ²
	10	Johnson et al. Characterization of LPCVD of Silicon Nitride in a Rapid Thermal Processor, Mat. Res. Soc. Symp. Proc. 146:345-350 (1989)	

Not considered: NO statement under 1.97He.

Examiner Signature		Date	
		Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

¹ Applicant's unique citation designation number (optional). ² Applicant is to place a check mark here if English language Translation is attached.